MACTEC ENVIRONMENTAL RESTORATION SERVICES, LLC

Spectral Gamma-Ray Borehole Log Data Report

Log Event A

Borehole 41-09-39

Borehole Information

Farm : SX **Tank :** SX-109 **Site Number :** 299-W23-234

N-Coord : 35,319 **W-Coord :** 75,829 **TOC Elevation :** 666.11

Water Level, ft : **Date Drilled :** 12/10/1996

Casing Record

Type : Steel-welded Thickness, in. : 0.375 ID, in. : 12

Top Depth, ft. : 0 Bottom Depth, ft. : 6

Type : Steel-welded Thickness, in. : 0.500 ID, in. : 6

Top Depth, ft. : 0 Bottom Depth, ft. : 130

Type : Threaded Ste Thickness, in. : 0.313 ID, in. : 4

Top Depth, ft. : 3 Bottom Depth, ft. : 225

Cement Bottom, ft. : 6 **Cement Top, ft. :** 0

Borehole Notes:

This borehole was drilled using a percussion hammer drilling method in a similar manner to borehole 41-12-01. A 15-degree cone drive-point was welded onto the bottom of a steel casing and the weld and the outside of the cone were ground smooth. Unlike borehole 41-12-01, there was no lip from the weld bead on the outside of the drive-point. The casing is flush threaded, 0.5-in. thick, with 7-in. outside diameter and 6-in. inside diameter. The casing was driven to a depth of 55 ft, the hole was logged and drilling and logging were then continued in 10 ft increments until a depth of 130 ft was reached. The successive drilling and logging method was employed as a way to quantify dragdown of contamination. The percussion hammer drilling method and operation are to be documented in a separate report.

Equipment Information

Logging System : 2 **Detector Type :** HPGe **Detector Efficiency:** 35.0 %

Calibration Date : 10/1996 **Calibration Reference :** GJO-HAN-13 **Logging Procedure :** P-GJPO-1783

Log Run Information

Log Run Number : 1 **Log Run Date :** 12/10/1996 **Logging Engineer:** Bob Spatz

Start Depth, ft.: 54.5 **Counting Time, sec.:** 100 **L/R :** L **Shield :** N

Finish Depth, ft. : 0.0 **MSA Interval, ft. :** 0.5 **Log Speed, ft/min.:** n/a

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Borehole 41-09-39

Log Run Number : 2	**Log Run Date :** 12/10/1996	**Logging Engineer:** Alan Pearson				
Start Depth, ft.: 63.5	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N			
Finish Depth, ft. : 61.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a				

Log Run Number : 3	**Log Run Date :** 12/10/1996	**Logging Engineer:** Alan Pearson	
Start Depth, ft.: 61.5	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 44.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 4	**Log Run Date :** 12/11/1996	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 72.5	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N
Finish Depth, ft. : 60.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 5	**Log Run Date :** 12/11/1996	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 61.5	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 53.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 6	**Log Run Date :** 12/11/1996	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 81.5	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N
Finish Depth, ft. : 62.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 7	**Log Run Date :** 12/11/1996	**Logging Engineer:** Alan Pearson	
Start Depth, ft.: 90.5	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 71.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 8	**Log Run Date :** 12/11/1996	**Logging Engineer:** Alan Pearson	
Start Depth, ft.: 99.5	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N
Finish Depth, ft. : 80.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 9	**Log Run Date :** 12/13/1996	**Logging Engineer:** Alan Pearson	
Start Depth, ft.: 108.5	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N
Finish Depth, ft. : 90.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

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Log Event A

Borehole 41-09-39

Log Run Number :	10	**Log Run Date :**	12/13/1996	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	117.5	**Counting Time, sec.:**	100	**L/R :** L	**Shield :** N
Finish Depth, ft. :	110.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	11	**Log Run Date :**	12/13/1996	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	109.5	**Counting Time, sec.:**	100	**L/R :** R	**Shield :** N
Finish Depth, ft. :	90.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	12	**Log Run Date :**	12/13/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	130.5	**Counting Time, sec.:**	100	**L/R :** L	**Shield :** N
Finish Depth, ft. :	110.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	13	**Log Run Date :**	12/13/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	110.0	**Counting Time, sec.:**	100	**L/R :** R	**Shield :** N
Finish Depth, ft. :	90.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	14	**Log Run Date :**	12/17/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	130.5	**Counting Time, sec.:**	100	**L/R :** L	**Shield :** N
Finish Depth, ft. :	110.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	15	**Log Run Date :**	12/17/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	110.0	**Counting Time, sec.:**	100	**L/R :** R	**Shield :** N
Finish Depth, ft. :	90.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	16	**Log Run Date :**	12/17/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	0.5	**Counting Time, sec.:**	100	**L/R :** L	**Shield :** N
Finish Depth, ft. :	6.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	17	**Log Run Date :**	12/18/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	5.5	**Counting Time, sec.:**	100	**L/R :** L	**Shield :** N
Finish Depth, ft. :	62.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Analysis Information

Analyst : J.R. Brodeur

Log Event A

Borehole 41-09-39

Data Processing Reference : Data Analysis Manual Ver. 1 Analysis Date : 01/08/1997

Analysis Notes :

After drilling and logging the first 55 ft, this borehole was drilled and logged in approximately 10-ft successive increments down to a depth of 130 ft. There were a total of 17 log runs for this borehole logging event, including initial log runs, log runs conducted under real time to quantify the high-rate zones, reruns, and a final complete set of repeat log runs covering the entire borehole. The intent of drilling and logging in 10-ft successive increments was to attempt to quantify contamination drag-down during drilling.

There were 17 field verification data obtained for the multiple log runs of this borehole. Six of those field verification data failed the qualification criteria. Those verification spectra were taken for log runs that included the depth region from 60 to 90 ft, the region of highest gamma-ray flux and the region of highest temperature in the borehole. Prior to and after these failures, the instrument performance did not demonstrate a continued problem. Therefore, the poor performance may be attributed to either the high count rate effects or to borehole temperature effects. It is not possible to quantify the contamination from the 60- to 90-ft depth region so there is no considerable quality problem with the overall borehole log. Also, in regions outside of the 60- to 90-ft depth region, reruns and log depth overlaps demonstrate excellent repeatability, verifying the quality of the assays outside of the high activity region.

The casing correction applied to the spectra during analysis was that for a 0.5-in. thick casing.

Cs-137 was the only man-made gamma-emitting radionuclide identified in this borehole. Surface contamination was detected from the surface to a depth of 6 ft. The assays of the surface region have not been corrected for the surface casing so the actual concentration has been underestimated. No Cs-137 was detected from 6 to 50 ft. From 62 to 90 ft the system was saturated except for a small interval near 69 ft. From 90 ft to TD at 130 ft there was moderate to high Cs-137. The highest concentration in this region was about 2,000 pCi/g.

From 60 to 110 ft, the spectra were analyzed without Gaussian fitting of the 662-keV peaks. The high Cs-137 activity of this region caused broadening of the peaks so, to capture all of the peak activity, it was necessary to simply do a channel-by-channel integration around the 662-keV peak. Below 110 ft and above 60 ft, all peaks were fit with Gaussian distributions prior to integration.

Repeat loggings were completed on all depth regions in the borehole and the repeatability is excellent.

The temperature of the air in the borehole was measured on two separate days using a simple hand-held thermocouple lowered into the borehole. Measurements were taken on the way down the borehole to prevent disturbing the air. For both measurements the borehole was allowed to stabilize for at least 48 hours before temperature logging. The data show a gradual increase from the surface to a maximum of about 130 degrees F at a depth of about 75 ft, then a decrease to 104 degrees F at the bottom of the borehole.

Of the natural gamma-emitting radionuclides, only K-40 could be quantified because of excessive attenuation of the gamma-ray signals by the extra thick casing. However, K-40 could not be assayed from 62 to 110 ft because the 1460-keV signal was obscured by an elevated Compton continuum noise resulting from a high gamma flux in this region. There is no character in the K-40 log other than an apparent low concentration region near the surface resulting from the dual string of casings.

Additional information and an interpretation of the data from this borehole will be provided in a separate letter report.

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Log Plot Notes:

Three log plots are provided for this borehole. Plot 1 shows the Cs-137 concentration for the entire length of the borehole. Concentration assays from all log runs are shown along with the 95 percent concentration confidence intervals. Plot 2 provides detail of the reruns from 90 to 130 ft. In some depth regions there are as many as five reruns. This plot also shows the 95-percent confidence intervals for each assay.

The third plot is a combination plot showing the Cs-137 concentration, the K-40 concentration, the temperature logs, and the total gamma log.

Additional log plots for apparent moisture content and from a high-rate gamma detector are provided in a separate report.